ON CERTAIN PECULIAR FUNGUS-PARASITES OF LIVING INSECTS[1]

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(WITH PLATES XVI–XIX)

During the past ten years the writer has examined many thousands of freshly collected insects of various sorts preserved in alcohol, which have come from various parts of the world, especially from tropical regions, and in looking them over for fungus-parasites, the possibility of encountering forms which might throw some light on the origin of the Laboulbeniales, yet not members of this group, has been constantly in mind. Although the hope of meeting with forms of this nature has not been realized, and nothing remotely related to these plants has been seen, apart from many genera and species which are entirely typical of the group, a certain number of wholly unrelated fungi have been observed, which appear to be as peculiar in their mode of life on living insects as are the Laboulbeniales themselves. Although few in numbers, these parasites belong to several quite unrelated groups, and seem to have adjusted themselves successfully to the uncertain conditions of life and propagation on rapidly moving living hosts. The apparent rarity of most of them seems quite remarkable, however, in view of the fact that any such exist; since, if a certain small number of insects furnish favorable conditions for such development, it is difficult to understand why hosts of other similar insects have not also been similarly parasitized, and why an extensive flora of this nature, or at least one comparable in numerical importance to that of the Laboulbeniales, has not been developed.

What may be called the idiosyncracies of such parasitism are well illustrated by equally inexplicable host relations or rather lack of host relations, between certain groups of insects and the Laboulbeniales. The ants, for example, would seem from their

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enormous numbers, gregarious habits, wide distribution, overlapping generations, and usual habitats, to offer the most favorable conditions for the development of a very large flora, but as yet only two forms of Laboulbeniales have been found on them. Their habit of cleaning themselves evidently does not interfere with the successful propagation of such parasites, since several typical genera and species are thus successfully attacked. That they rarely become hosts, however, seems to be indicated by the fact that, among the many that have been examined both by the writer and by Professor WHEELER, whose attention has been called to this matter for some years past, none have been found which appear to be hosts for any forms except the common *Laboulbenia formicarum* of America, and the apparently equally common *Rickia Wasmanni* of Europe. On the other hand, the most nondescript type among those described below is an ant-parasite; although its characteristics are not such as would have been expected to makes its parasitism successful on any type of insect.

Of the five genera herewith enumerated, three, including the form on ants just mentioned, are very closely allied to well known genera of Hyphomycetes, the species of which are either saprophytes or parasites on other plants; and did they not occur on living hosts, might have been regarded as accidental saprophytes which had developed after death; dead insect remains being, as is well known, a very prolific source of such forms. Since, however, all the insects examined in the present connection were collected while living, directly into alcohol, and some were examined by the writer while still alive, there can, it would seem, be no question as to the true nature of the relation in these instances. Of the two remaining genera, one comprises species also belonging to the Hyphomycetes, but not closely related to any described types, while the other seems to be more nearly related to the Chytridiales than to other known organisms.

In comparing the miscellaneous assemblage of forms which are now known to live as external parasites on living insects, it is of interest to note that a great majority, at least, possess one characteristic in common, namely a more or less clearly defined, blackened footlike structure which serves both as an organ of

attachment to the host and a means of absorbing such materials as are necessary for growth. In other words, the foot is also a haustorium. Among the Laboulbeniales, those forms which, like *Dimeromyces rhizophorus*, perforate the host's integument, may be assumed to derive their nutriment directly from the fluid materials which surround their deeply penetrating rhizoids; in fact this conclusion seems unavoidable. But that a very closely allied species like *D. coarctatus*, which possesses a typical foot and does not penetrate, although it grows under identical conditions on a soft-bodied host, should use materials which are either of a different nature or derived from a different source, seems not at all probable. In the opinion of the writer, even those forms which grow on spines or hairs or thin wing-membranes obtain their food supply from the same source as do the penetrating forms, namely from the circulatory system, which by diffusion or otherwise supplies the structures mentioned in the living insect. There seem certainly to be no differences in the vegetative characteristics or in the peculiar fatty cell contents in any of the Laboulbeniales which would suggest that the nutrition of these plants is not the same in all cases. The assumption that the food material is obtained directly from the circulation seems further supported by the fact that individuals which grow nearer the circulatory centers, as for example about the bases of the two anterior pairs of legs, or along the chief circulatory channels, are usually larger and more luxuriant. That any considerable portion of their food is derived from the integument itself seems quite improbable in view of the host-relations of the penetrating forms. An examination of the accompanying plates will show the presence, in most instances, of a blackened footlike structure similar in a general way to that of the Laboulbeniales, and in the writers' opinion these plants, also, may be assumed to obtain their food materials from the circulatory system through the medium of this haustorium.

Among entomogenous Fungi Imperfecti, one other type has been observed on living insects, which is not herewith included; for the reason that, as yet, no definite spore-formation has been seen in any of the several species examined. These plants consist of colorless, septate, copiously branching filaments, which grow

on various parts of small silphids, especially, and on the wings of certain flies in the tropics. They may produce conspicuous and dense tufts, and in some instances correspond very closely in external form to types of *Cladophora*. No characteristic foot is developed and no definite spores have been seen, propagation being effected, as far as can be determined, solely by fragmentation.

Hormiscium myrmecophilum, nov. sp.—Plate XIX, figs. 22–25

Filaments nearly hyaline becoming brownish, darker near the base, closely septate, the cells often as broad as, or broader than long, undifferentiated, distally bluntly rounded, erect or curved upward, rigid, simple, less frequently sparingly branched, tapering but slightly if at all, one to several arising from a deeply blackened foot of variable size and shape. Maximum length about 280 μ by 7–8 μ in width.

On various parts of *Pseudomyrmex* sp., Amazon (MANN).

This plant was received from Mr. W. H. MANN, who found it growing on a majority of the individuals taken from a nest of *Pseudomyrmex*, while he was acting as entomologist of the Leland Stanford Expedition to Brazil in 1911. It is sufficiently large to be readily visible as it projects from the surface of the host, and, although it is such an insignificant type, possesses sufficient individuality to distinguish it. It produces no definite spores or differentiated cell-groups, as far as has been observed, and appears to propagate itself by fragmentation only, the filaments proliferating, as indicated in the figures, after a terminal portion has been broken off. The opaque and somewhat variable "foot," by which the individuals are attached to the surface of the host, appears to correspond to such a small fragment broken from a hypha, which, adhering laterally, becomes blackened and indurated, and gives rise to new filaments, while at the same time it serves the office of attachment as well as of food absorption. It is not, however, so firmly fixed as is the case with most of the Laboulbeniales, and might be easily removed by its host from portions of the body which can be reached by the mouth. When one considers the habits of cleanliness which characterize most ants, it seems singular that

a type like the present should be able to establish itself successfully. It is possible that an examination of fresh specimens might show the presence of some more or less viscous secretion from the hyphae, which enables them to adhere readily and firmly to any surface with which they may come in contact, but there seems to be no indication that such is the case in the alcoholic material.

It may here be mentioned that several other imperfect forms have been seen on ants. Among them one has been found by the writer in the vicinity of Cambridge, which forms blackish incrustations on various parts of the host and gives rise to a few short, colorless, erect branches. It has not been possible, however, to determine the nature of this plant. Another form has recently been mentioned by Dr. BISCHOFF (Berl. Ent. Zeitschr. 57:(2), 1912), as occurring on living ants at Potsdam, which possesses brown hyphae and grows on various parts of the host in tufts. No further details as to its structure are given, and it is uncertain whether it is related to the present form.

Muiogone, nov. gen.

Entomophilous; pulvinate. Sporophores short, simple, hyaline, crowded. Spores terminal, solitary, dark, muriform, the cells of the mid-region distinguished from those of the basal and terminal portions, which bear more or less conspicuous median processes or spines.

Muiogone Chromopteri, nov. sp.—Plate XVI, figs. 1–3

Sporophores short, slender, several-septate, crowded so that the spores form a compact spreading pulvinate mass on the surface of the host. Spores irregularly oblong or piriform, usually broader distally and tapering slightly at the base; the cells very numerous and arranged in about twelve tiers which are regular, except distally; four or five of the middle tiers remaining subhyaline or variably suffused with dirty brownish yellow; contrasting, though not abruptly, with the nearly opaque blackish brown basal and terminal regions; the cells of the latter more prominent, forming a sort of cap; all of them, especially the upper which are slightly irregular, usually slightly flattened distally, and bearing a spine-

like process, straight or curved, sometimes stouter and distally perforate, sometimes obsolete: the cells of the basal tiers similarly modified, less prominent, flattened; the spinous process minute or obsolete. The whole sporiferous pustule, in the type, 330 μ in diameter by 210 μ deep. Spores 62–77×32 μ, the stalk (broken) about 25×7 μ.

On the inferior surface of the abdomen of *Chromopterus delicatulum* Beck., Kamerun, West Africa.

A single specimen of the apparently rare host, bearing this very peculiar fungus on its abdomen, was found in a collection of flies sent me by the Rev. GEORGE SCHWAB, to whom I am very greatly indebted for this as well as for numerous similar favors, and to whom I owe the remaining forms from Kamerun described below. Since there is but a single specimen, I have been unwilling to destroy it in order to determine the exact relation of the fungus to its host, and have merely removed a certain number of spores with a needle point from the general mass, which is firmly adherent to the soft integument of the inferior surface of the abdomen. This mass is somewhat diagrammatically illustrated in fig. 1, where it is shown *in situ* on the insect's body; but whether the vegetative hyphae penetrate the integument, or merely adhere firmly to its surface, cannot be determined in its present condition. The spores (fig. 2), which are in different stages of development in different parts of the mass, the younger ones mostly near the edges close to the substratum, are easily detached, and carry with them a portion of the slender stalk, which is probably somewhat longer than is represented in the figures. The cap-cells of the spore are distinctly different from those of the paler mid-region, and their terminal processes vary greatly in development. In some instances (fig. 3) they are much stouter, and seem certainly to be distally perforate; although in others this is quite evidently not the case, and it is barely possible that they may be associated with some viscous secretion which might aid the spore in attaching itself to a new host. No such secretion, however, can be detected in the present condition of the material; although, as in the case of the *Hormiscium* just described, as well as in the species of the following genus, it is difficult to imagine how the parasitism of such forms

can be successful in the absence of some contrivance to insure adherence to a moving host. The cells of the lower tiers of the spore, though more prominent than the smaller ones of the middle region, are distinctly flattened, and the minute apical projection, when present, can only be distinguished along the margin.

The genus is perhaps too near *Sporidesmium*, and I have had some hesitation in separating it under a new name. The differentiation of its spores, however, into specialized distal, basal, and middle regions, of which the last is probably the functional portion, corresponds in a general way to that seen in the spores of the following genus, and, taken in connection with its entomogenous habit, may perhaps be considered as sufficient reason for regarding it as distinct. It seems not improbable that the sporiferous pustule arises from the multiple germination of the paler mid-region of the spore, which must include nearly one hundred cells, in some cases.

Muiaria, nov. gen.

Entomophilous, more or less deeply suffused throughout, growing in dense, more or less isolated tufts, or rarely repent, each tuft attached by a blackened base in which the vegetative hyphae may be indistinguishable; the tufts consisting of fertile, or both sterile and fertile elements; the sterile, when present, simple and not clearly distinguished from the sporophores; the latter bearing terminally solitary spores which are not abjointed, or, as a rule, clearly differentiated from them. Spores at first transversely septate, consisting of a slender terminal portion and a broader main body in which two flat central cells are distinguished that become several times longitudinally divided, after usually dividing once transversely; the cells adjacent to these four central tiers often showing occasional longitudinal or slightly oblique divisions; the stalk and distal prolongation sometimes producing a short but characteristic spurlike process.

This genus, which inhabits living flies in the tropics, so closely resembles certain types of *Macrosporium* that, as in the case of *Muiogone*, I have hesitated to give it a new name. It seems, however, to possess certain peculiarities, in addition to its very different habit of life, which are sufficiently distinctive to render

a generic separation desirable. In only one species, *M. repens*, does it assume a repent habit, such as is illustrated in fig. 6, and in this instance only on the host's wing. This may be due in part to the less nutritious character of the substratum; yet other species, when they occur in the same situation, retain their isolated tuft-like habit, which is also characteristic of this species when it occurs on the body or legs of its host (fig. 8).

The spores, which always resemble those of *Alternaria* in general form, differ from those of *Macrosporium* in being inseparable from the sporophore, a portion of which breaks off with them, and in the characteristic differentiation of the central portion, which consists of two similar flattened cells; which, in all the species except *M. repens*, become divided once transversely before the appearance of a few longitudinal septa. The four tiers of small cells which result are usually clearly distinguishable, as is indicated in fig. 4; and with the exception of *M. repens*, the vegetative portion is hardly developed; a tuft of more or less divergent elements being attached by a compact blackened base, which may or may not be associated with slight rhizoid-like outgrowths. The body of the spore is flattened, so that when it is viewed edgewise, it is often hardly broader than the stalk and tip. Both the spores and their stalks are brittle, and it seems probable from the appearance of very small plants which are sometimes found growing on hairs or spines, that propagation may be effected by small detached fragments as well as by whole spores, from which the larger groups appear to arise; although in the latter case, it is seldom possible to determine definitely that a portion of the general blackened base is made up of the old spore body. The spurlike processes which may arise in some species (figs. 9), either from the stalk just below the spore, or from the slender termination of the latter, sometimes in both positions (figs. 4 and 5), are characteristic, but are not present invariably or in all the species.

The body of the spore, sometimes also its termination and the whole or a portion of the stalk and sterile elements, if they are present, are irregularly mottled or lined by a somewhat darker incrustation which gives the surface a somewhat roughened appearance. This superficial modification tends to obliterate the longi-

tudinal divisions of the cells when they occur, so that they often cannot be clearly distinguished without the use of an immersion.

It is evident from an examination of the sporophores, that after a spore has matured and has broken off, the portion of the stalk which remains proliferates distally and produces a new spore. Since this may be repeated several times, the spore-formation in a given tuft may be more or less continuous, even if new sporophores are not produced.

Although the species of this genus, all of which occur on living individuals of small flies, are so unlike other entomogenous types, they appear to be similarly limited to definite hosts. This seems to be very distinctly the case, for example, in *M. repens*, which has been seen on numerous individuals all belonging to a single species, apparently, of the genus *Clasiopa*, while no others among the very numerous and often closely related flies, which were collected with them in the same locality, are thus parasitized.

In addition to the species described below, a few others are known, but from lack of sufficient material these are not herewith included.

Muiaria gracilis, nov. sp.—Plate XVII, figs. 12–13

Olivaceous, forming a tuft attached by a compact, footlike, blackened base. Spores and sporophores very long and slender; the body of the spore not abruptly distinguished from its long terminal portion, or from the sporophore; the cells of the four central tiers very small; the adjacent cells above and below usually undivided by longitudinal septa; the whole rather inconspicuously marked by more or less elongated darker areas separated by lighter somewhat labyrinthine lines, this modification involving the upper portion of the sporophore and the lower two-thirds, or more, of the slender spore-termination; the spore outline even, with hardly indicated indentations at the septa or with none. Total length of spore and stalk 300–480 μ, the stalk about 7 μ in diameter, the body of the spore 14–17 μ in diameter.

On the legs and inferior surface of the abdomen of *Leucophenga* sp., no. 2299, Kamerun, West Africa (SCHWAB).

This species is well distinguished by its very slender form and the great length of its spores and sporophores. In one or two of the tufts it seems possible to distinguish the body of the spores, from the middle segments of which they seem to have arisen, lying flat against the substratum.

Muiara Lonchaeana, nov. sp.—Plate XVII, figs. 10–11

Scaly-punctate throughout, or almost hirsute. Sterile and fertile elements relatively rather short and stout, densely crowded; the sterile elements numerous. Basal cell of the spore usually rather abruptly distinguished from the sporophore, which is often shorter than the spore itself; the body of which is irregular, its basal and distal cells variably inflated and constricted at the septa, rarely divided longitudinally. Spores 100–140×15–18 μ, the stalk 35–70×8 μ.

On the abdomen, legs, and antennae of *Lonchaea* sp., no. 2298, Kamerun, West Africa (SCHWAB).

This species is characterized by its dense habit of growth, dark color, conspicuously and coarsely scaly-punctate spores, which are more irregular in outline than those of the other species, and are borne on relatively short stalks. The sterile elements are more than usually numerous and are roughened much like the spores. In certain instances small groups have been observed which seem certainly not to have sprung from entire spores, but rather from small fragments. Two specimens of the host were found to be parasitized.

Muiaria armata, nov. sp.—Plate XVI, figs. 4–5

Forming a compact tuft with narrow base. The stalk and spore-termination pale, relatively slender and rather abruptly distinguished from the body of the spore; which is relatively broad, rather rich brown, the four middle tiers clearly distinguished; the cells immediately above and below divided by occasional longitudinal septa; the outline comparatively even, and streaked in a somewhat labyrinthine fashion by darker crustlike areas, which are wholly absent on the stalk and distal portion of the spore; either or both

of which may be furnished with a simple, usually somewhat recurved spurlike outgrowth which may, however, be wholly wanting. The sterile elements scanty. Total length of stalk and spore 210—260 μ; average length of spore to tip 120 μ; body of spore 60×18–24 μ, the termination 3.5–4 μ broad. Spur from spore-tip about 20×4 μ, that from the stalk somewhat longer.

On the legs of *Drosophila* sp., no. 2178, Sarawak, Borneo.

This very distinct form was found among material for which I am greatly indebted to the kindness of Mr. J. C. MOULTON, and has been seen on a single specimen only of its host. It is clearly distinguished by the relatively broad and evenly curved outline of the body of its spores, their characteristic markings, relatively slender termination, and by the peculiar spurlike processes, which may arise from the latter, as well as distally from the sporophore, or may be wholly absent.

Muiaria repens, nov. sp.—Plate XVII, figs. 6–9

Repent on the wings or growing in tufts on other parts of the host; brown, concolorous. Repent form producing rather closely septate, somewhat tortuous hyphae, tending to run in straight lines, sparingly branched, bearing solitary spores here and there, or small groups of spores along the anterior wing margins or along the larger veins. The spores in both types rather short and stout; the two middle tiers not transversely divided; the cells above and below them similar, or hardly distinguishable, and showing several longitudinal septa; the stalks somewhat shorter than the spore, as a rule, and usually bearing a subterminal spurlike process. Sterile elements not distinguished. Spores 60–70×15 μ, those on the wings somewhat smaller. Total length including stalk 70–100 μ.

On the wings and abdomen of *Clasiopa* sp., no. 2283, Kamerun, West Africa (SCHWAB).

This species is unlike those previously described from the fact that the four tiers of small cells, usually present in the middle of the spore body, are replaced by two tiers of relatively larger cells, which are often so similar to the cells immediately above and

below, that they are hardly differentiated from them. This appears to be due to the fact that the two median flattened cells from which these tiers are formed do not divide transversely, as in the other species, before the longitudinal septa appear. In one group, a portion of which is represented in fig. 8, the spores have begun to germinate *in situ*, and it is noticeable that the rhizoid-like germ tubes all arise from cells of the middle region. Although other species have been found growing on the wings of flies, it is only in the present instance that a creeping series of hyphae is produced, in place of the usual compact tuft. This repent habit seems therefore to be specific. The species seems to be distinctly limited to a single host, of which perhaps two dozen have been found infested, and here it may be remarked that the species of *Stigmatomyces*, which inhabits the same insect, was found to occur much more rarely. It is thus evident that, however unsuited such a form as the present may seem to its parasitic habit, it is actually quite as successful as the *Stigmatomyces*, which is so peculiarly adjusted to this mode of life.

Two other forms very closely allied and perhaps identical with this species, but less definitely repent and differing in minor points, have been examined on species of *Clasiopa* from Sarawak and from Trinidad; but sufficient material is not available for a definite determination in either case.

Chantransiopsis, nov. gen.

Entomophilous. Filaments firm, elastic, persistent, thick-walled, colorless, septate, growing in variably developed tufts attached to the body of the host by an opaque black base, or foot; variably branched; the terminal branches sterile or fertile, and bearing solitary terminal simple spores successively abjointed.

This type was first found growing on living specimens of the staphylinid beetle *Xantholinus* near Fresh Pond, in Cambridge, where scanty material, largely sterile, was obtained in the autumn of 1900 and 1902. Later, among a number of Javan beetles sent in alcohol by the late F. ROUYER, two more genera of staphylinids were found to be similarly infested, as well as a third species belonging to the Hydrophilidae. Although it has been sought for on

thousands of other insects belonging to these families which have been examined, this type has not again been seen, and must thus be assumed to be very rare or local. Having in mind their possible floridean derivation, it was at first thought that this type might prove to be connected with some genus of the Laboulbeniales, and to represent a form corresponding in some manner to the monospore-producing *Chantransia*-forms among the Rhodophyceae, the general habit of the plant and its spores suggesting a resemblance of this nature. There seems to be not the most remote possibility, however, that such is actually the case. These plants are not associated with any forms of Laboulbeniales which might by any chance form part of their life cycle, and they have no inherent characteristics, except their similar habitat, which would point to such a connection.

The spores are, as a rule, rather sparingly produced, and at maturity the outer wall appears to be somewhat viscous or gelatinous, so that they may perhaps more readily adhere after being abjointed. In many instances, as is indicated in figs. 19 and 21, a collar is present below the developing spore, which seems to indicate that the usually somewhat smaller terminal cell of the fertile branch is proliferous, and continues to abjoint spores after the first has been separated. In this process the terminal cell enlarges, pushing upward, and soon divides by a partition coincident with the plane of separation of the first spore, which is indicated by a slight ridge or collar. The upper of these two cells becomes the new spore, and after it has been separated, the lower, renewing its activity, produces a third spore in a similar fashion, and so on.

The filaments are quite colorless and appear white on the living host. They may be simple, or several times branched, varying considerably in this respect. In one Javan species, not herein included, since it is sterile, a copious development of mostly unilateral branchlets takes place; some of the longer branchlets being elongate and attenuated, as well as spirally coiled at the tips. The filaments are also apt to be beset by masses of bacteria, and in some cases by attached infusoria. The spores usually contain one or more large fatty masses, and the contents of the cells are rather

coarsely granular-reticulate. The deep black foot is usually small and clearly distinguished. In *C. stipatus*, however, it forms a more extensive black crust, a portion of which, only, is shown in fig. 17, from which the crowded filaments arise in a mass. Three species are here distinguished, and there are one or two other Javan forms in the material at hand, which may prove to be distinct, and another from the Philippines.

Chantransiopsis decumbens, nov. sp.—Plate XVIII, figs. 19–21

Filaments divergent or decumbent, flexed or reflexed, colorless, rather scanty, long and slender, simple or once to several times branched, rather closely septate below the terminal sterile branchlets; which are more remotely septate and taper slightly to their blunt tips, which are very rarely more attenuated and slightly spiral. Spores long-elliptical or subpiriform, 30–35×9–11 μ. Total length of branches about 230 μ, the longest 350 μ, with an average diameter of about 6 μ.

On the inferior surface of an undetermined staphylinid beetle, Malang, Java (ROUYER).

This species differs from the others which have been examined by its more or less decumbent habit, some of the filaments lying in contact with the surface of the host. Its large spores are somewhat broader than those of the following species, from which it also differs in its small foot and spreading flexed and stouter filaments. The spores seem to be more frequently produced than in the other species.

Chantransiopsis stipatus, nov. sp.—Plate XVIII, figs 17–18

Filaments densely crowded; erect, straight, or but slightly flexed, rigid, hardly tapering, closely septate, usually once branched near the base; arising from a spreading opaque blackened insertion. Spores elongate, distally rounded, nearly isodiametric, or slightly broader in the middle, 25–32×8 μ. Filaments about 110×5 μ.

On the inferior surface of a staphylinid beetle allied to *Tachinus*, no. 1401, Java (ROYER).

This species differs from the preceding in its densely crowded, erect, nearly straight filaments, which seldom branch, except close to the base, and in its somewhat smaller, narrower spores. Its insertion is an opaque black crustlike structure, from which large numbers of filaments arise in a dense tuft. Only a portion of this crust is shown in the figure.

Chantransiopsis Xantholini, nov. sp.—Plate XVIII, figs. 14–16

Filaments somewhat densely tufted, sometimes rather copiously branched; erect, slightly flexed, arising from a small and well defined opaque black foot. Spores relatively small, ovoid to oblong, 10–18×5–6 μ. Filaments 70–175×5–7 μ.

On the inferior surface of the thorax of *Xantholinus obsidianus*, Fresh Pond, Cambridge.

This species is smaller in all respects than the two preceding forms. The outline of the successive cells tends to become slightly convex, and the spores are rather short and stout. The species has been collected but twice, in October 1900, and again in 1902 in the same locality; but although it has been repeatedly sought for elsewhere, it has not again been met with, and may be regarded as very rare.

A small tuft of a different species has also been observed on a species of *Xantholinus* from the Philippine Islands, but the specimen is not sufficient for description.

Amphoromorpha, nov. gen.

Entomophilous; consisting of two superposed cells surrounded by a firm common envelope, which becomes perforate at the apex for the escape of numerous naked amoeboid(?) spores into which the upper cell becomes completely divided; the base attached to the host by a well developed blackened foot.

The position of this genus is quite uncertain. It is known only in its fully mature condition, the characteristics of which seem to correspond more closely to those of some of the Mycochytridineae than of any other organisms. The spores, into which the upper of the two cells appears to divide *in toto*, seem to possess no walls,

and their irregular outline suggests that they may be amoeboid in character. No appearance has been seen which would suggest the presence of cilia. The lower cell is surrounded by a very thin membrane which, in a few specimens, is made visible through the shrinkage of the protoplasm; but no indication of this division can be seen in the general envelope, which is continuous from base to summit like that of the Laboulbeniales.

All the individuals examined are, as has been mentioned, quite mature, and the distal region is filled in every case with closely packed spores, except in the individual represented in fig. 28, from which the contents has for the most part escaped through a rupture at the base. It is therefore not possible to determine what the course of development is; whether, after the discharge has taken place the basal cell enlarges so as to fill the cavity, and again cuts off a terminal cell which divides as before, or whether there is but one such period of sporulation in the history of an individual. It is evident, however, from a comparison of different individuals, that the relative space occupied by the spore-mass and by the basal cell varies greatly, and it is not impossible that the original spore-mass may be pushed slowly out by pressure from the enlarging basal cell which, after it has filled the whole cavity, cuts off an upper portion which divides into spores that are again pushed out by the further growth of the cell below. Such a process would correspond very closely to that described, for example, in *Cladochytrium Alismatis* by CLINTON, in which, however, the successive sporangia empty completely through the swarming of the zoospores at the moment of maturity. Unless the spores of the present type are actively amoeboid, some mechanical means for emptying the sporangium, like that above suggested, seems necessary, since there is no indication that the spores are furnished with cilia.

In addition to the organism herewith described, several others have been noticed that appear to be similar in their general characters. One of these is clavate in shape, much smaller than the present form, and is found occasionally on Carabidae or on Laboulbeniae growing on these hosts in New England, but of this no material is at the moment available. A second type occurs commonly on a variety of insects and rarely on Laboulbeniae infesting

them, and is represented in figs. 30–31. That these organisms belong to the same category seems very probable; but since their development has not as yet been satisfactorily followed out, these figures are given merely to call attention to their existence. They usually grow on the bristles, antennae, or legs of their hosts, and closely resemble germinating spores of Laboulbeniales, or might be mistaken, when mature, for male individuals of Amorphomyces or Dimeromyces. There is no reason to believe, however, that they have any connection whatever with the Laboulbeniales. The individuals, which always terminate in a more slender necklike portion, consist of a basal cell attached by a black foot, above which two other cells appear to be, as a rule, obliquely related. Of these the upper appears either to abjoint or become divided into small spermatium-like bodies, which pass out through a terminal pore. Until their development has been more carefully examined, however, it has seemed best not to give names to such species as are in the possession of the writer. Of the forms illustrated, fig. 31 occurs on *Labia minor*, the others on Staphylinidae.

Amphoromorpha entomophila, nov. sp.—Plate XIX, figs. 26, 27

Pale yellowish brown, translucent, amphora-shaped, the body long elliptical or tapering below to the narrow base, abruptly contracted distally below the well defined subcylindrical terminal neck, the apex of which is slightly compressed and truncate; the foot relatively large, pointed below, somewhat spreading, black. Total length 110–130 μ, the body 70–105$\times$28–31 μ, the neck 14–17$\times$7.5–8 μ; spores about 4 μ; foot 35$\times$17 μ.

On the bristles of *Diochus conicollis* Motsch., and species of two other genera of Staphylinidae; also on a species of (?) *Labia*, Manila, Philippines.

The hosts bearing this curious plant were found among a number of miscellaneous insects which Mr. C. S. BANKS of the Bureau of Science was so kind as to have collected for the writer. The individuals are solitary, and occur in small numbers projecting at an acute angle from the bristles of the legs, or of other portions of the body. Being much larger than many Laboulbeniales, they are readily seen, but no other insects have been found which

bear them, with the exception of a small bug, also from the Philippines, on two specimens of which a closely allied or perhaps identical form (fig. 29) was obtained, but not in sufficient numbers for description. It differs in its smaller size and broader blunt discharge tube.

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EXPLANATION OF PLATES XVI–XIX

The figures are reduced from camera drawings made with Zeiss dry objectives and eye-pieces and the Leitz water immersion as indicated.

Muiogone Chromopteri Thaxter

FIG. 1.—Abdomen of host showing a pustule of the fungus growing on the under surface; A4.

FIG. 2.—Two detached spores with broken stalks; D12.

FIG. 3.—Tip of a spore greatly magnified, some of the spines distally perforate; water im. 12.

Muiaria armata Thaxter

FIG. 4.—A tuft of the fungus growing on the host's leg; D4.

FIG. 5.—Two spores showing the scaly modification of the surface; D4.

Muiaria repens Thaxter

FIG. 6.—General habit of repent form on the hosts wing; A4.

FIG. 7.—Small portion of the same enlarged.

FIG. 8.—Portion of a tuft growing on the abdomen in which the spores are germinating; D4.

FIG. 9.—Surface view of single spore with basal spur and below it the ring indicating proliferation; D4.

Muiaria Lonchaeana Thaxter

FIG. 10.—Tuft of the fungus from abdomen of host showing scurfy character of the surface and rhizoidal outgrowth from base; D4.

FIG. 11.—Single spore in optical section; D4.

Muiaria gracilis Thaxter

FIG. 12.—Tuft of the fungus growing on leg of host; D2.

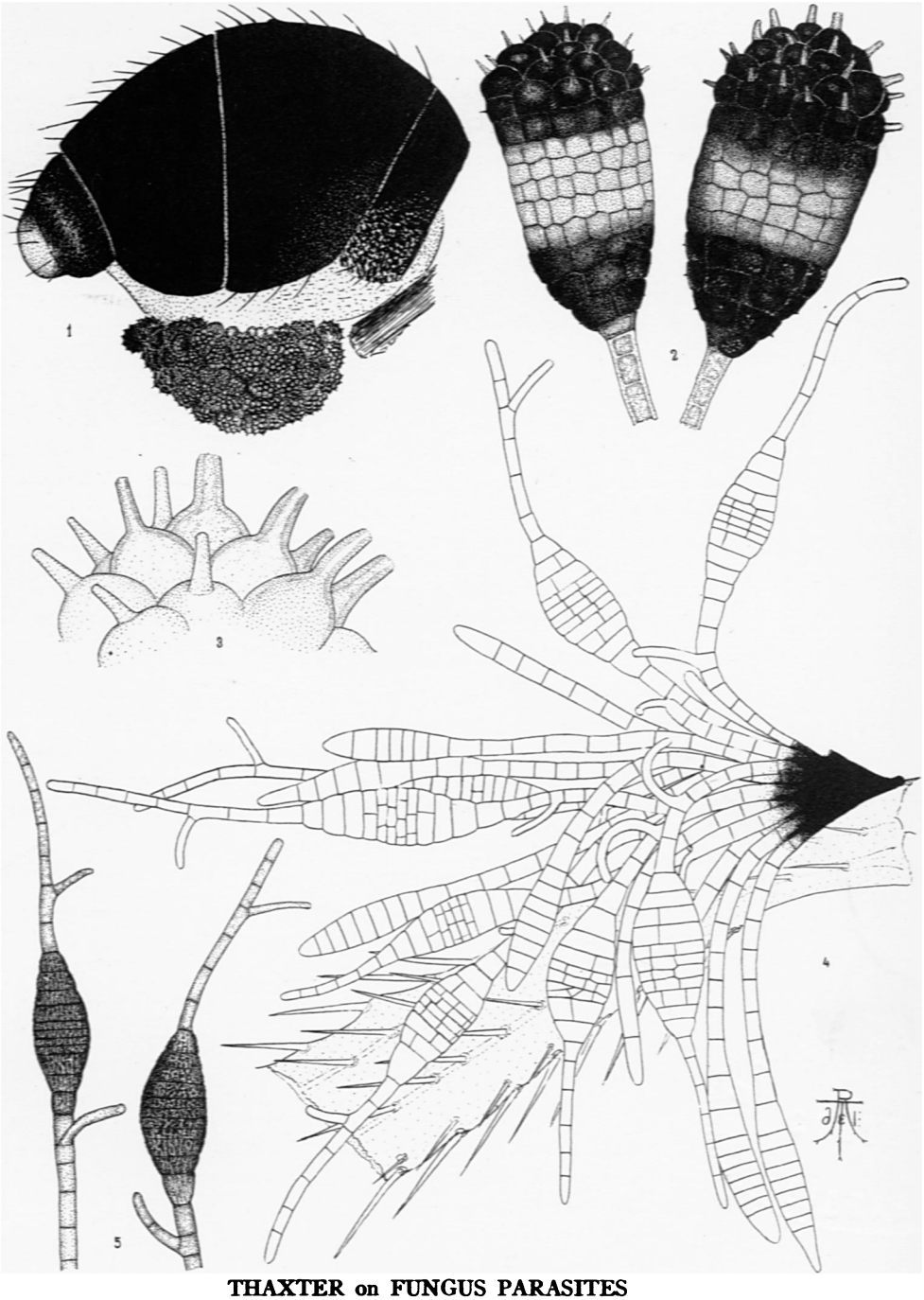
FIG. 13.—Single spore showing character of surface; D4.

Chantransiopsis Xantholini Thaxter

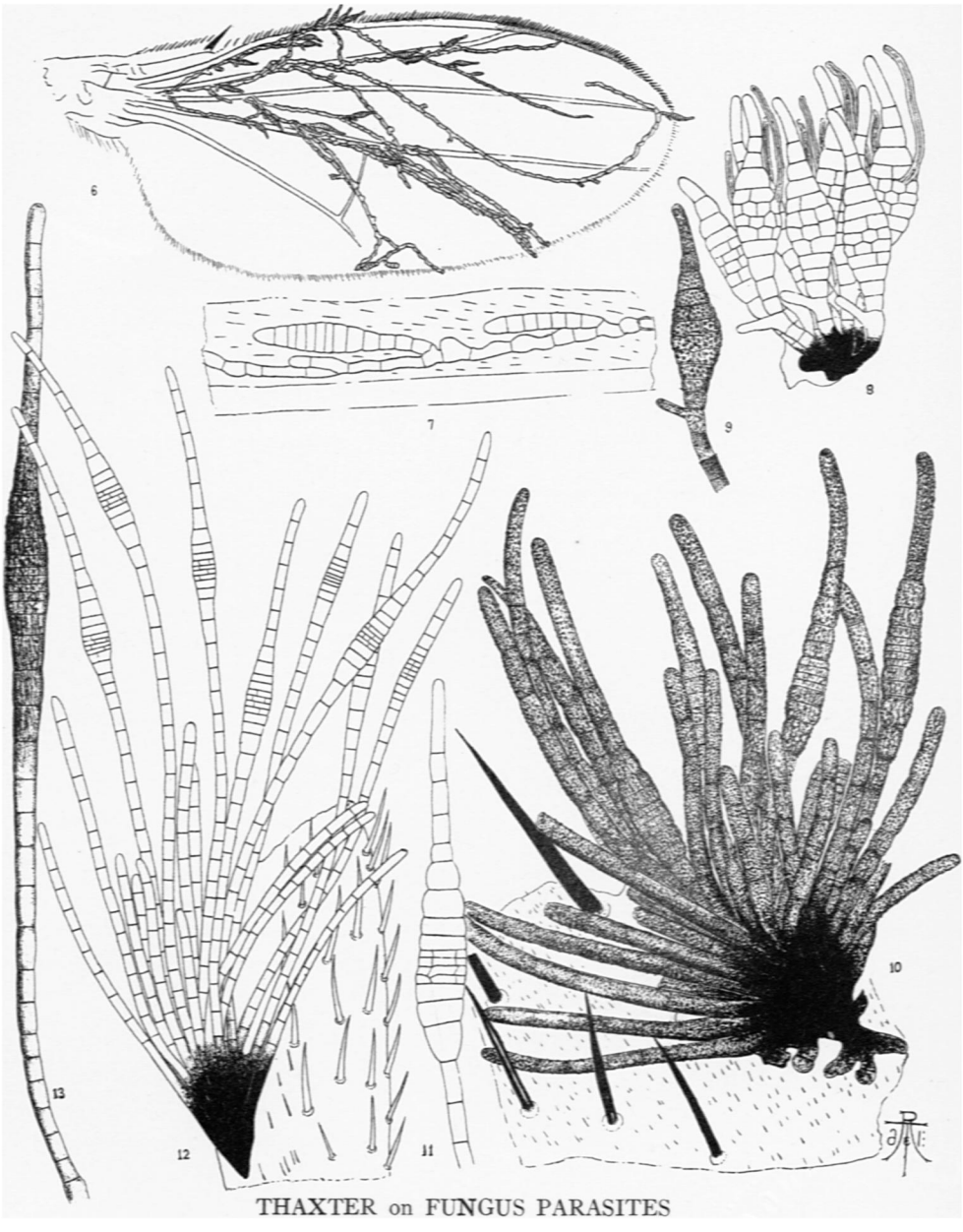
FIG. 14.—Rather large tuft with numerous spores; D4.

FIG. 15.—Tips of two sporiferous branchlets; water im. 4.

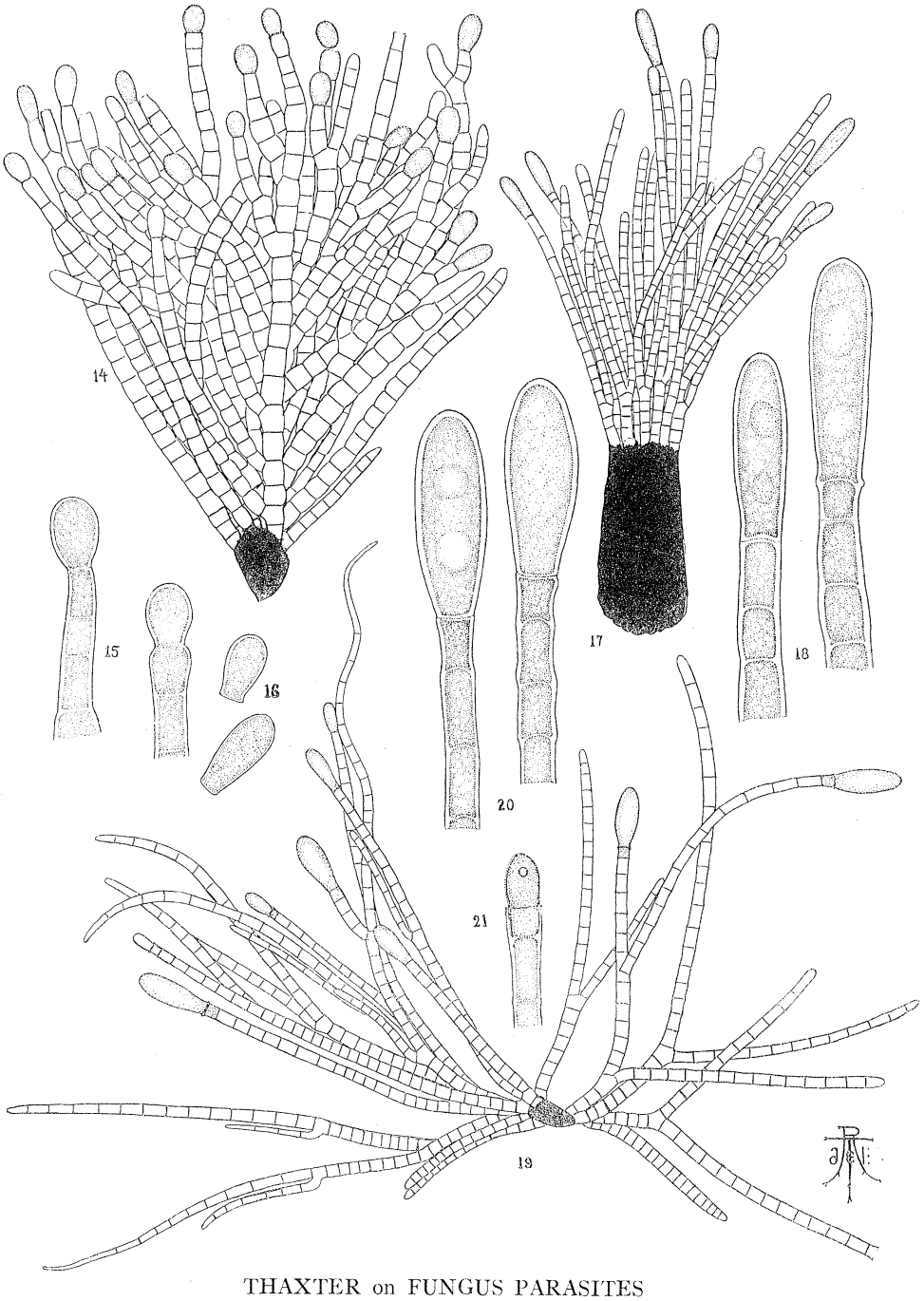
FIG. 16.—Two spores; water im. 4.



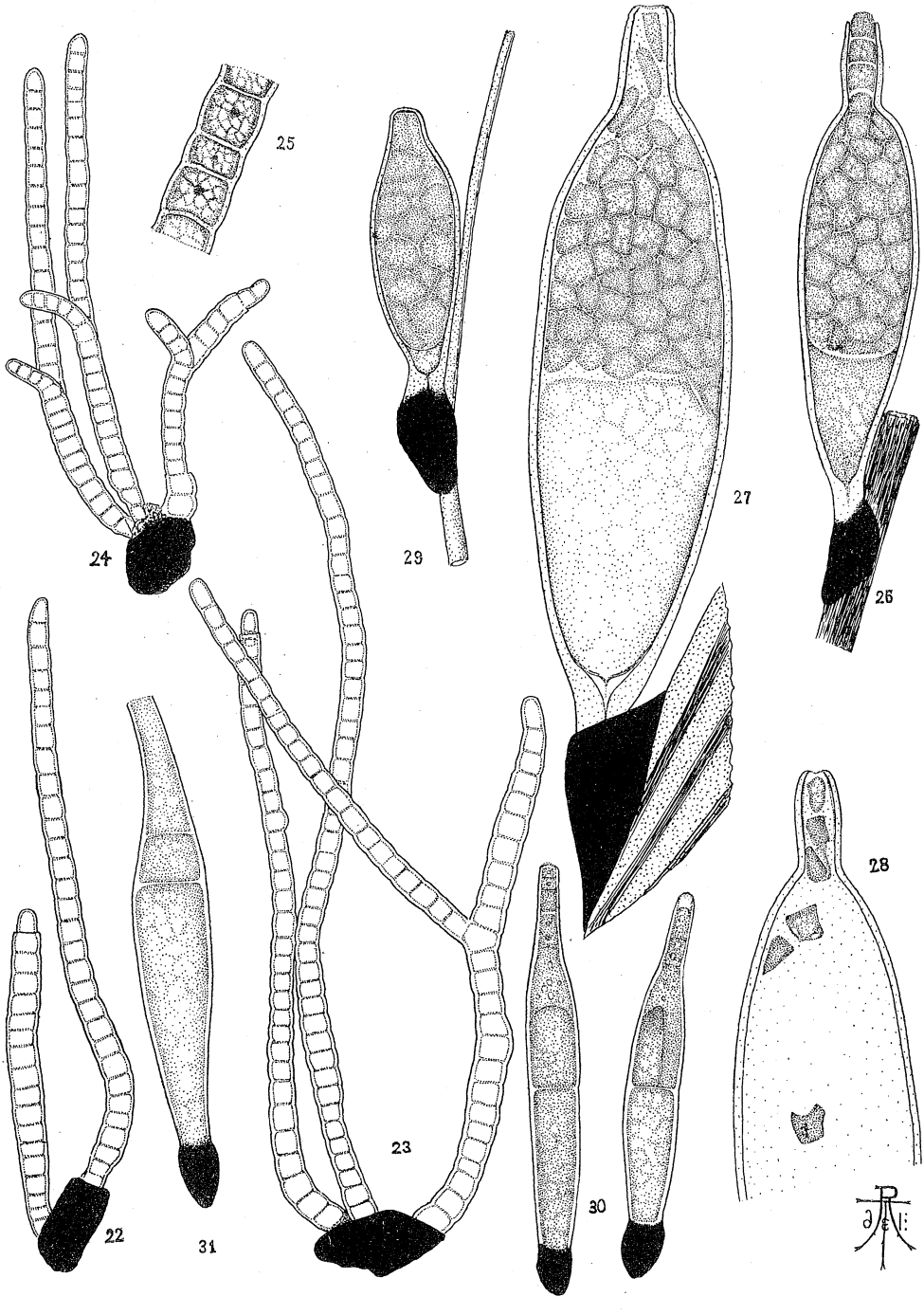
THAXTER on FUNGUS PARASITES



THAXTER on FUNGUS PARASITES



THAXTER on FUNGUS PARASITES



THAXTER on FUNGUS PARASITES

Chantransiopsis stipatus Thaxter

FIG. 17.—Portion of a much larger tuft, arising from an extensive blackened base; D2.

FIG. 18.—Tips of two sporiferous branchlets; water im. 4.

Chantransiopsis decumbens Thaxter

FIG. 19.—A whole plant showing characteristic habit; D2.

FIG. 20.—Tips of two sporiferous branchlets; water im. 4.

FIG. 21.—Tip of sporiferous branchlet showing secondary spore-formation by proliferation; water im. 4.

Hormiscium myrmecophilum Thaxter

FIGS. 22–24.—Characteristic habits of entire plants; D4.

FIG. 25.—Small portion of a filament enlarged; water im. 4.

Amphoromorpha entomophila Thaxter

FIGS. 26–27.—Two individuals *in situ;* water im. 4.

FIG. 28.—Upper portion of broken individual with isolated spores; water im. 4.

Amphoromorpha sp.

FIG. 29.—Individual from small Philippine bug; water im. 4.

FIG. 30.—A related organism from staphylinid beetles; water im. 4.

FIG. 31.—A species similar to the last from *Labia minor;* water im. 4.